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motivation

Worldwide, many existing reinforced concrete structures are in urgent need of structural repair or strengthening due to:

- deterioration and
- growing load capacity demands.

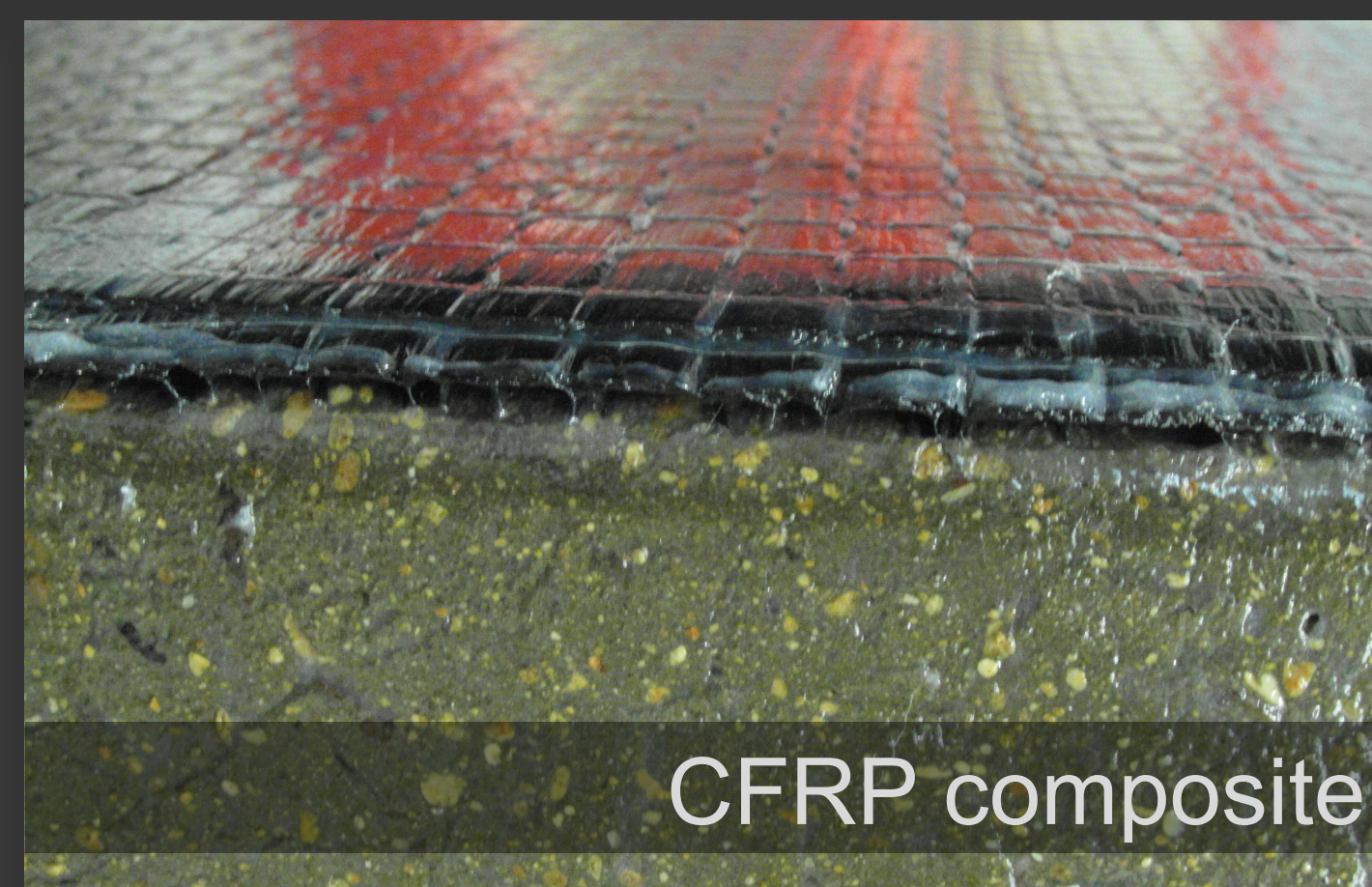
In the UK alone, the vast majority of concrete bridges built since the 1930's are deemed no longer capable of sustaining increased traffic volumes.

It is estimated that there are approximately:

- 10,000 trunk road and motorway bridges and
- 150,000 local road bridges.



Woven CFRP fabric



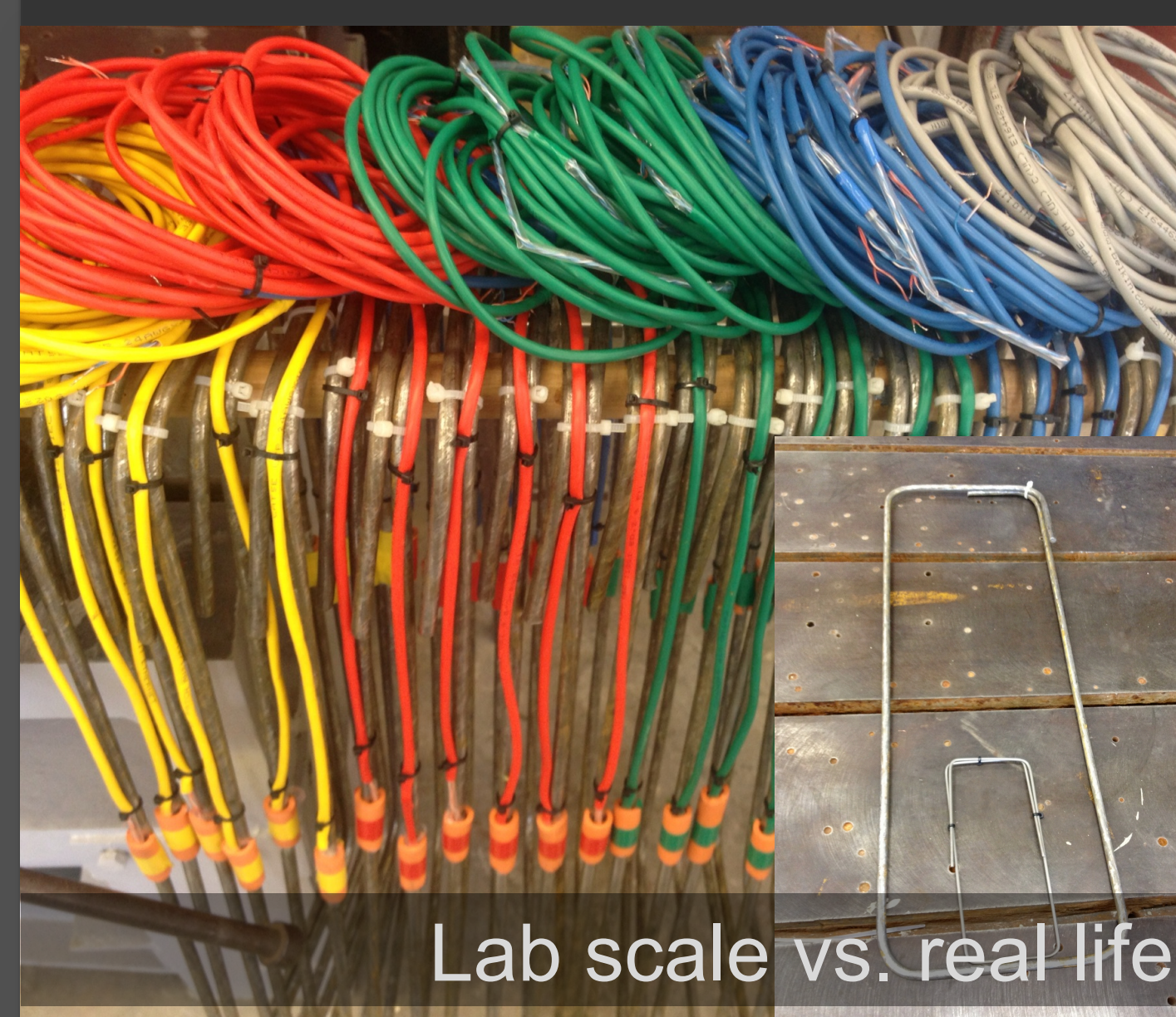
CFRP composite

Investigation of the most commonly used design assumption of load sharing in shear:

$$V_{\text{ultimate}} = V_{\text{concrete}} + V_{\text{steel}} + V_{\text{composite}}$$

Studied parameters:

- Varying percentage of shear reinforcement
- Varying thickness of applied composite materials
- Bond length and anchorage influence on strength
- Load distribution and sharing between components
- Various strengthening solutions using bars and sheets



Lab scale vs. real life



Typical reinforcement

findings

Experimental investigation on push-off specimens revealed that

$$V_{\text{ultimate}} \neq V_{\text{concrete}} + V_{\text{steel}} + V_{\text{composite}}$$



Courtesy Fibrwrap®
© Lee Chapman Photography

Advanced composites offer:

- Improved traditional repair technologies
- Prolonged life of existing concrete structures
- Innovative and cost-effective design solutions
- Solutions specific to strengthening project needs

approach

Mechanical tests include:

- Large push-off specimens
- Realistic T-beams of various sizes
- Composite materials – sheets & bars
- Traditional materials – steel & concrete

A number of mechanical tests on realistically sized reinforced concrete elements are necessary in order to develop reliable composite strengthening design guidelines.



Steel cage assembly



Casting

Intermediate conclusions:

Advanced composites can contribute significantly to the ultimate shear capacity of reinforced concrete elements. Performance of strengthened reinforced concrete elements is dependent on strengthening solution, bond length and anchorage of the CFRP materials.